

GEOLOGIC MAP OF THE MTM -85000 QUADRANGLE, MARS; K. E. Herkenhoff,
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The geologic map presented here covers the portion of Mars between latitudes 82.5°S to 87.5°S, longitudes -20°W to 20°W. The Viking orbiter 2 images used to construct the photomosaic base used for mapping were taken during the southern summer of 1977, with resolutions no better than 140 meters/pixel. A digital mosaic of Mariner 9 images was also constructed to aid in mapping. The Mariner 9 images were taken during the southern summer of 1971-72, and have resolutions as high as 85 meters/pixel. However, usefulness of the Mariner 9 mosaic is limited by incomplete coverage and atmospheric dust opacity.

The most common bedrock unit in this quadrangle is the polar layered deposits, first described by Murray *et al.* [1] and Cutts [2]. The layered deposits are characterized by smooth morphology and gently sloping, asymmetrical troughs. Visibility of layers is limited by the resolution of available images, but layering in the southern part of the map area appears similar to that in other parts of the layered deposits in terms of topographic expression, dip, and thickness [3]. Only one primary impact crater has been recognized in the layered deposits on this map [5]. It is about 17 km in diameter and appears to be partly obliterated by erosion of the layered deposits on its north side. While this crater has clearly been modified, its generally circular shape and the preservation of secondary craters in its vicinity are strong indications that the layered deposits have not been deformed significantly by "glacial" flow. This observation has implications for the rheology of the layered deposits and, therefore, the composition and average temperature of the bulk of the deposits.

The layered deposits appear to have been eroded to expose a basal unit in the northern part of the map area. Tanaka and Scott [6] used Viking Orbiter images to map this area as layered deposits, although layering is not visible in many places. The lack of impact craters and generally smooth morphologic forms suggest that this unit is either very young or recently exhumed. A similar unit was recognized by Herkenhoff and Murray in the MTM -85080 quadrangle [7]. In both areas, the unit does not completely obscure underlying topography, so it must be less than 1 km in thickness. The resolution of available images does not allow the stratigraphic relations between this unit and the layered deposits to be inferred, so it is mapped here as layered deposits.

The residual polar cap, areas of partial frost cover and two nonvolatile surface units overlying the layered deposits are also mapped here. These units were first recognized and mapped by Herkenhoff and Murray [8] at 1:2,000,000 scale using a color mosaic of Viking Orbiter images that was corrected for the effects of atmospheric scattering. This mosaic and an additional Viking color mosaic were used to confirm the identification of five color/albedo units within this quadrangle: (1) bright, neutrally colored polar frost (unit At), (2) bright red dust mantle (unit Am), (3) darker, less red layered deposits (unit Al), (4) a mixture of frost and bare ground having intermediate color and albedo (unit Af), and (5) dark, neutrally-colored saltating material (unit Ad). Because the resolution of the color mosaics is not sufficient to map these units in detail at 1:500,000 scale, contacts between them were recognized and mapped using higher resolution (black and white) Viking and Mariner 9 images.

The bright, red dust mantle (unit Am) does not appear to obscure topography, and is therefore probably no more than a few meters thick, and perhaps much less. The extent of the dust mantle changed in some areas during the 3 Mars years between the Mariner 9 and Viking missions, indicating that it is ephemeral. The dust mantle interpretation is also consistent with thermal inertia models of Viking IRTM data that show that the thermal inertia of the surface of the layered terrain is very low [9].

The location of dark, neutrally colored material (unit Ad) in topographic depressions in the south polar region indicates that it is transported by saltation [8]. It may be composed of sand-sized particles or low-density aggregates of dust grains, and is more abundant in other parts of the layered terrain outside of this map area. Dark material (unit Ad) is found only on exposed layered deposits, suggesting that saltation of dark particles strips away the dust

mantle. Local saltation of the dark particles in unit Ad would also be expected to eject dust grains into atmospheric suspension, or allow them to trickle down between dark particles and out of sight. This unit may have been deposited recently, perhaps with particle motion continuing until the present. Image resolution is insufficient to resolve dune forms, and there is no evidence of temporal variations in the extent or location of the dark material.

Areas mapped as partially covered by frost (unit Af) generally have uniform albedo at the resolution of available images. This unit is interpreted as a mixture of seasonal frost and bare ground based upon its albedo, color, and temporal variability. Although patches of frost and bare ground can be distinguished in some places, the length scale of mixing is commonly below the resolution of the images. Areas of this unit are observed to darken as summer progresses, suggesting that CO₂ frost is subliming throughout the season. Topographic roughness on centimeter to decameter scales may allow seasonal frost to remain in shadowed depressions, protected from solar heating. Many of the boundaries between the partial frost cover and adjacent units are narrowly gradational at the resolution of the images.

With the exception of areas covered by perennial frost, the south polar layered deposits appear to have undergone net erosion in the recent geologic past. Solar heating of the deposits causes sublimation of the water ice within them [10,11], probably forming a lag deposit of non-volatile material. Such a nonvolatile layer would protect underlying water ice from further sublimation. Herkenhoff [12] proposed that minor amounts of dark, magnetic dust exist in the layered deposits along with the bright, red dust (unit Am) that covers much of the Martian surface. The magnetic dust may preferentially form filamentary sublimation residue particles [13] that eventually erode and saltate, ejecting the remaining dust into suspension. Dark, low-density particles less than 1 mm in size will continue to saltate until trapped by an obstacle or in a depression, forming isolated patches of dark material (unit Ad). Eventual destruction of such particles could allow the dark dust to be recycled back into new layered deposits via atmospheric suspension.

The above scenario is consistent with the color, albedo, and geology of the units mapped here, but the existence of denser sand grains (solid or porous) in the dark material cannot be ruled out. The thin dust mantle appears to be a temporary feature, perhaps deposited during a major global dust storm such as that observed in 1971. Where it has been removed by winds, the water ice in the layered deposits is protected from further sublimation by a weathering rind of dust and residue particles. Layers may be currently forming where frost remains on the surface throughout the year [8].

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